VHF – FM NARROWBAND BASICS
INSTRUCTIONS TO THE INSTRUCTOR

Inform students to bring their radios for a programming exercise during the course.

Download instructions on programming radios from http://radios.nifc.gov/. These instructions are used for the programming exercise.

Print off this lesson plan and print one copy for each student. Students can follow along during the presentation.

Instructors will need to ensure the classroom has a whiteboard, flip chart, and markers.

FACILITATION NOTES:

This lesson is designed to be interactive with student participation. PowerPoint slides are ***not*** included and instructors are encouraged to draw visual representation of key concepts while facilitating discussion. Example visuals are included in this package to help instructors illustrate key concepts.

To save time, instructors may want to draw the examples prior to starting the course.

DETAILED LESSON OUTLINE

COURSE: VHF-FM Narrowband Basics

TIME: 2 Hour

TRAINING AIDS: A variety of radios for hands on demonstrations; whiteboard, flipchart, markers.

OBJECTIVES: Upon completion of this unit, students will be able to:

1. Describe the difference between wide and narrowband frequencies.

2. Identify common symptoms of bandwidth mismatches and the effects on the operational environment.

3. Describe mitigation actions to manage bandwidth mismatches.

4. Recognize whether your radios are in wideband or narrowband mode and be able to change that functionality through programming.

5. Identify local cooperators and radio interoperability concerns.

I. NARROWBANDING, A BRIEF BACKGROUND.

USING THE CHANNEL SPACING GRAPHIC ON PAGE 1.13, ILLUSTRATE THE DIFFERENCE BETWEEN WIDEBAND AND NARROWBAND. FACILITATE DISCUSSION.

A. Why the Switch to Narrowband?

- In order to increase the number of available frequencies for government use
- Many federal agencies, including wildland fire agencies, use radio frequencies between 162MHz and 174MHz. These frequencies are used in multiple settings across the nation, and by many different agencies.
- In the federal frequency band, the available frequencies went from 480 to 960. This expansion has limited benefit for the federal fire fighting agencies.
- In theory, this increased the number of useable frequencies, but we have not seen the benefits in the fire community.
- Bottom line is frequencies cost money. The government spectrum is worth billions.
  - Where there was one frequency now there are two.
  - Increasing the number of usable frequencies reduces frequency congestion.

Definition: **P25** is a standard to which radios can be built. It means, among other things, that the radio is capable of analog, digital or multi mode, and that channels can be programmed in narrow or wide band. It should be understood by students that narrowband versus wideband is not the same as digital versus analog.

B. When Did the Change Occur?

- In 1995, Congress mandated that all federal agencies transition to narrowband frequencies by January 1, 2005.
- In the future narrowbanding will continue to be the standard:
  - In 2013, the FCC (state and local) will require all VHF frequencies to be narrowband.
  - When technology permits, each 12.5kHz frequency will again be divided in half, resulting in an even narrower frequency of 6.25kHz. It should be noted that this narrowbanding process will occur in only digital mode. This is way in the future.

C. Why New Radio Equipment?

- Narrowbanding halved a frequency's bandwidth and deviation.
- Many older wideband radios will not operate in narrowband mode.
- An older wideband radio's bandwidth is 25kHz wide. This could interfere with adjacent narrowband frequencies.
- An older wideband radio may cause the following problems when operating in a narrowband environment:
  - A narrowband radio may not process the wideband signal, resulting in no received audio.
  - The narrowband radio may process the signal into a bad received audio signal (garbled, distorted, etc.).

II. DESCRIBE THE DIFFERENCE BETWEEN WIDE AND NARROWBAND FREQUENCIES.

A. A Channel is Defined By It's…..

- Frequency
  - Every channel on a radio has a specific frequency.

NARROWBANDING DOES NOT DECREASE THE AMOUNT OF TRANSMITTING POWER.

- Bandwidth
  - Wideband – uses a range 25kHz wide.
  - Narrowband – uses a range 12.5kHz wide. *(half the wideband bandwidth)*

USING THE ROAD ANALOGY AND INFORMATION PIPELINE GRAPHICS ON PAGES 1.14 AND 1.15, LEAD A DISCUSSION EXPLAINING THE NARROWBAND AND WIDEBAND PROCESS. DRAW THE FIGURES SO STUDENTS CAN SEE AND FOLLOW ALONG.

B. What is the difference between Wideband vs. Narrowband?

- Frequency separation
- Frequency division

III. IDENTIFY COMMON SYMPTOMS OF BANDWIDTH MISMATCHES AND THE EFFECTS ON THE OPERATIONAL ENVIRONMENT.

A. Interference

- Interference occurs when both wideband and narrowband are used to communicate on the same channel or adjacent channels.
- This is the cause of many of our current communication problems.
- Individual channels can be programmed for either wide or narrowband. It is imperative that channels be programmed appropriately for wideband or narrowband as required, (e.g., response to fires under state or local jurisdiction may be operating in wideband mode).
- Not all cooperators and federal agencies are narrowband capable. Remember, however, that federal frequencies are licensed as narrowband frequencies and must be used as such.

B. Possible Mismatches

- Symptoms of bandwidth mismatches come in two ways:
  - Narrowband to wideband
  - Wideband to narrowband

  These symptoms are exacerbated by variabilities in voice inflection, volume, pitch, etc. Background noise will also contribute to Narrowband/Wideband mismatch problems.

  DEMONSTRATE WITH TWO HANDHELDS, GET PERSON WITH LOUD VOICE FOR DEMONSTRATION

1. Narrowband Communication on a Wideband Channel

- Received narrowband audio may be very soft and quiet.
- Audio signal may not be processed by the wideband receiver.

a. Mitigation Measures

- Get a narrowband capable radio as soon as possible or program into the appropriate mode.

<u>Temporary Solutions:</u>

- Wideband radios must turn up volume to hear the narrowband signal.

2. Wideband Communication on a Narrowband Channel

- Received audio may be loud, distorted, or inaudible. *It should be noted that these symptoms are inconsistent and variable in how they present themselves.*

<u>Examples</u>:

One of your transmissions may be unreadable but the next one is clear. Possible causes are excessive background noise or increased voice level.

An Aircraft transmission may be extremely loud, garbled or cut out.

A radio may work in the hands of one person, but not another due to voice characteristics (loud or soft).

When transmitting on a wideband channel through a narrowband repeater the audio may cut out.

a. Mitigation Measures

- Get a narrowband capable radio as soon as possible or program into the appropriate mode.

Temporary Solutions:

- Turn down the volume, but note you may not hear narrowband communications.
- Speak quietly.
- Don’t speak directly into the microphone.

IV. RECOGNIZE WHETHER YOUR RADIOS ARE IN WIDEBAND OR NARROWBAND MODE AND BE ABLE TO CHANGE THAT FUNCTIONALITY THROUGH PROGRAMMING.

GROUP EXERCISE. BREAK STUDENTS UP INTO GROUPS BY RADIO TYPE AND USE THE NARROWBAND PROGRAMMING TRAINING AID ON PAGE 1.17 TO WALK STUDENTS THROUGH THE PROCESS OF SWITCHING BETWEEN WIDEBAND AND NARROWBAND.

V. IDENTIFY LOCAL COOPERATORS AND RADIO INTEROPERABILITY CONCERNS.

The federal fire agencies' standard is narrowband communications. When working in an interagency environment (fed, state, cooperators) it is likely that you will find different standards, some wideband, different systems, different frequency bands, etc.

So, it can be expected that potential for communication conflicts can exist every time you work with nonfederal cooperators.

Take this time to discuss the following bullet points:

- Who are your cooperators?
- Is there a communications plan in place?
- Does everyone know the plan?
- Identify who is responsible to initiate the plan.
- Identify radio equipment capability (wideband, narrowband, frequency band).

VI. SUMMARY

As professional firefighters we have the responsibility to understand the tools we use for communication: These responsibilities include, among others, the following:

- Knowing where to go to have your radio maintained.
- Ensuring your radio is maintained on an annual basis.
- Knowing how to program your radio.
- Knowing about frequencies. Simply getting a frequency is not enough. You have to ask the question, "Is the frequency wide or narrow?"

A. Avoiding Problems

- Know whether the frequencies are wide or narrow and make sure your radio is programmed accordingly.
- Be aware of the symptoms of bandwidth mismatches, and take positive action to help mitigate the problems.
- If possible, issue narrowband capable equipment to those with wideband only equipment.
- Establish reliable communications before entering the field.

B. Programming Help

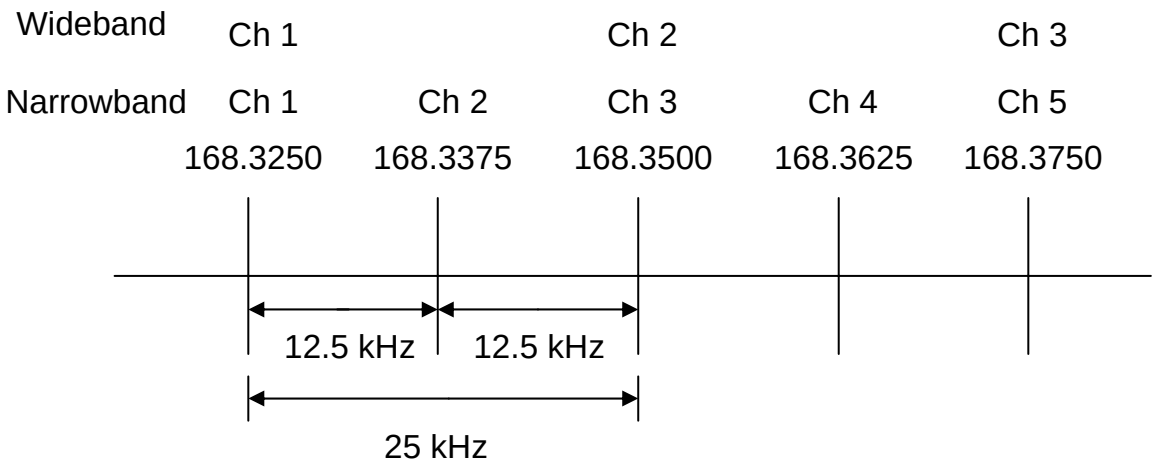
The http://radios.nifc.gov/ site has up-to-date tips, news, and troubleshooting information. Check this site to find the following information:

- How to verify if radio is narrowband or wideband.
- How to program your radio for narrowband or wideband operation.

QUESTIONS, COMMENTS, CONCERNS

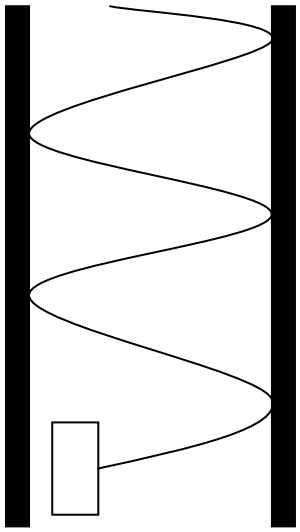
NOTES

Channel Spacing



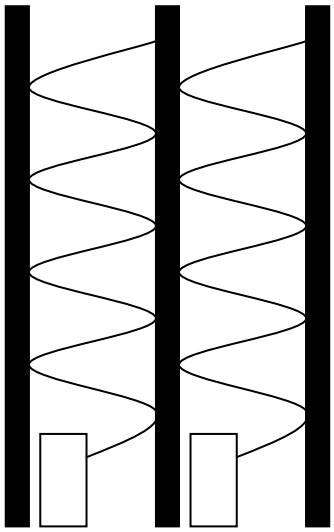
Road Analogy

Wide Road



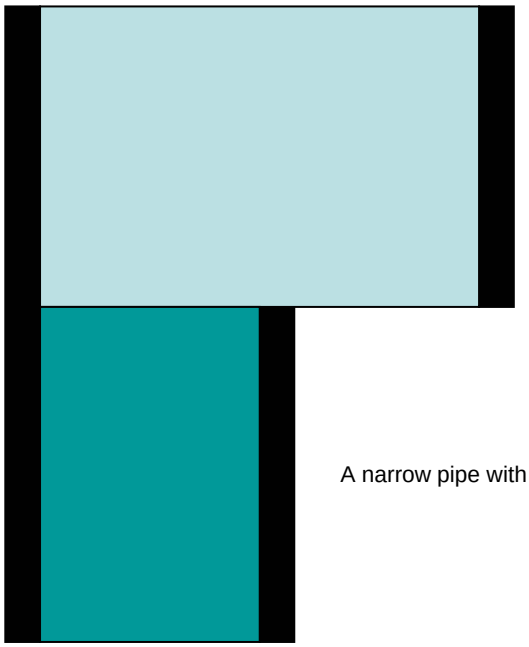
With wide lanes (wideband) a car can move in the lane this much.

Narrow Road



With narrow lanes (narrowband) a car can only move in the lane this much. If you drive like your still in wide lanes you will cause problems with other cars.

Information Pipeline



A wide pipe with water

A narrow pipe with water

How to tell if your radio is Narrowband

King GPH/DPHx Portable

- ✓ Must have the radio in programming mode
- ✓ When you put in the channel to be edited, you will see the channel number and a capital "N". This will tell you that channel is narrowbanded.
- ✓ If the "N" is not present, press the # sign on the keypad and it should appear.
- ✓ To toggle between narrow and wideband, simply press the # key on the keypad.
- ✓ Remember that each channel is programmable, so just because one channel is narrowband does not mean they are all programmed in the narrowband mode.

King EPH Portable

- ✓ When checking the King EPH, it is very important to check to see if you get the word PASS when you put the password in for programming.
- ✓ If you get the word PASS, hit "enter" and then enter channel number with key pad, and hit "enter" again. You should now see the "N" next to the channel number (if programmed in the narrowband mode) and you can change it from narrowband to wideband by pressing the # key on the keypad.
- ✓ If you do not see the word PASS, then you will have to program the radio by using a computer or cloning and will not be able to tell whether it is narrowband or wideband unless you upload the radio program to a computer and look at it there.

Thales RACAL Portable and Datron Guardian Portable

- ✓ When you turn the radio on, you will see on the bottom of the display either "An" (analog narrowband) or "Aw" (analog wideband).
- ✓ To change the channel you must go to the channel programming.
- ✓ Toggle down to B/W. Hit enter. Using the up and down arrow, you can change between 12.5khz (narrowband) and 25khz (wideband). Hit enter to save setting.
- ✓ Remember that each channel is programmable, so just because one channel is narrowband does not mean they are all programmed in the narrowband mode.

EF Johnson 5100 Portable

- ✓ Press F2 and go to keypad prg.
- ✓ Toggle to Chan Parms, press F2
- ✓ Toggle to Chan Space, press F2
- ✓ You will see Narrow or Wide, toggle between the two and set to appropriate setting. Press F2 to set.
- ✓ Remember that each channel is programmable, so just because one channel is narrowband does not mean they are all programmed in the narrowband mode.

Please refer to http://radios.nifc.gov for more specific details on programming any of the radios listed above.

INCIDENT RADIO COMMUNICATIONS PLAN	1. Incident Name	2. Date/Time Prepared	3. Operational Period Date/Time

4. Basic Radio Channel Utilization

Ch #	Channel Name *Tac 1*	Assignment *Division A*	RX Freq Narrowband (N) or Wideband (W) *168.XXXX N*	RX Tone/NAC *None*	TX Freq Narrowband (N) or Wideband (W) *168.XXXX N*	TX Tone/NAC *110.9*	Mode Digital (D) Analog (A) Multi (M)	Remarks
1								
2								
3								
4								
5								
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5. Prepared by (Communications Unit)